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ABSTRACT

The number of students in the science classroom who are learning English as a Second Language is increasing each day. This paper describes preliminary results of a California-based Teacher Enhancement project intended to increase elementary school teachers' science knowledge and ability to teach science to minority students and to promote the acquisition of English as a Second Language among English Language Learners. In a previous paper, success in changing teacher beliefs about their ability to teach science and their students' abilities to learn was discussed. It was noted, though, that there was very little impact on teacher beliefs about their ability to impact the science education of English Language Learner (ELL) students. This paper examines possible reasons for this and discusses some preliminary data suggesting why ELL students present such a strong challenge to science education. Additionally, it discusses further activities for addressing the needs of ELL students. (ZWH)

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Science Education of 'Limited English Proficient" English Language Learners

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Science Education of 'Limited English Proficient',
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Introduction

This paper describes some preliminary results of a California-based Teacher Enhancement project intended to increase elementary school teachers' science knowledge and ability to teach science to minority students and to promote the acquisition of English as a second language among English Language Learner (Riggs, Brasch & Diaz, 1992).

The science education of minority students, especially students who are learning English as a second language is critical for the future of states such as California, Texas and Arizona. Schools in urban and suburban school districts such as Los Angeles, Detroit, Chicago, to name just a few, already have a 'minority' majority of students. Additionally, a significant proportion of these students are students for whom English a second language. In California schools English language learners represent 20-25 percent of the student population. The majority of them (fifty-five percent) speak Spanish as their primary language. Given the large numbers that these students represent in California and Southwestern states it is imperative that educators address both their science education and their English language learning. This paper describes attempts that we have

[1] We prefer the term English Language Learner [ELL] to these terms because it more accurately represents the educational situation of these students and avoids possible negative connotations of terms such as 'limited' demographic untruths [at least in California schools] that such students are the 'minority' group.

made through this project to do both.

Science Education and Teacher Effectiveness

The project was funded by the National Science Foundation to offer elementary school teachers opportunities to enhance the effectiveness of their science teaching by providing them with training in implementing an activity-based science curriculum (FOSS, Britannica, 1990) and complex instruction for the education of bilingual students (Cohen, 1989; De Avila, 1983). Data were collected to measure teacher efficacy and outcome expectancy belief (Riggs, et al., 1994; Riggs & Enochs, 1990). The research presented here is a preliminary analysis of the impact the project is having with English Language Learners (ELL's).

The project is based in a school district in Southern California that is demographically typical of most schools in the area. A majority of its students are minority, and a significant proportion are ELL's. The district, like many in the Southwest is critically short of bilingual credentialed teachers and/or those who have received special training to work with students who are learning English as a Second Language. This paper examines how participating teachers are working to implement activity-based science and used it to support English language learning.

In a previous paper (Riggs, et al., 1994) we have described some success in changing teacher beliefs about their efficacy in teaching science through activity-based lessons:

> Overall, the project clearly had the desired impact in reference to the effectiveness of science teaching practiced by participating teachers. The implementation of appropriate pedagogy and resulting classroom success apparently had an effect on certain teacher beliefs, especially those related to the value of activity and beliefs in their ability to conduct a successful science lesson (Riggs, et al., 1994, p. 12).

Despite great success in changing teacher beliefs and attitudes about their own ability to teach science and their students' abilities to learn, there was very little impact on teacher beliefs about their ability to impact the science education of ELL students. As Riggs et al. (1994) report, almost all project teachers still selected the survey item that read, "Though I believe science is important for all students, I have concern that some students' limited English may inhibit their own and/or other students' learning of science." This current paper examines possible reasons for this result and discusses some preliminary data suggesting why ELL students present such a strong challenge to science education. Additionally, it will discuss future activities for addressing the needs of ELL students.

Issues Related to the Education of English Language Learners

Student who do not speak English when they enter school are at a great disadvantage because they have at least two major educational obstacles to overcome. First, they must learn how to

communicate effectively in English so that they can participate successfully in the classroom. Second, and equally important, they must, simultaneously, learn the academic content of lessons at the same rate and level as their English-speaking classmates. Cummins (1986) has argued that educators must provide appropriate support for the acquisition of English by ELL's and recognize that it is a process that may take five to seven years. To that end he proposes that bilingual instruction and developmentally appropriate ESL be provided to ELL's at all grade levels. This is much more difficult than its seems, however, in light of a dearth of appropriately trained teachers.

Cummins also notes that there may be an equally compelling factor that helps to account for the poor education of language minority students. This is the negative perceptions prevalent in society toward non-English speakers. These attitudes filter into educational institutions through teachers, staff and students. The perceptions are largely that ELL's will have educational difficulties due to "deficiencies" related to lack of English, cultural differences, socioeconomic status and lack of parental support. In another paper we call these unexamined attitudes toward these students "habitudes" (Flores, Teft-Cousin, & Diaz, 1992). These habitual, unexamined attitudes are stereotypic misconceptions that are, for the most part, untrue and which research has continually shown are not necessarily detrimental to educational achievement if appropriate pedagogical approaches are implemented (cf. Diaz, Moll & Mehan, 1986; Flores & Diaz, 1992;

Moll & Diaz, 1989, Moll & Greenberg, 1990).

A third, more general, consideration has to do with the nature of science teaching in classrooms. Lemke (1986) and others (Bettencourt, 1991) have argued that the nature of science and scientific discourse is alien to the discourse of classrooms. Lemke (1985) proposes that science teaching uses a blends scientific discourse, regular classroom talk and everyday talk that causes conflict and confusion among teachers and students. Hence, the poor performance in science among a majority of students in U.S. schools. The nature of science teaching, then, poses a double jeopardy to students who are not only trying to learn science but also acquire English as a second language. As Lemke (1985) notes, the nature of this coded language in science teaching is such that, "[s]peakers of nonstandard dialects of English, those whose first language is not English, and those from social groups that use different strategies [from those used in science teaching]...will be at a particular disadvantage" (p. 226)

A similar theme is taken by Bettencourt (1991) who straightforwardly proposes that "science" is completely alien to the world of teachers and students. He states that,

> ...[D]espite three hundred years of a worldview informed by the natural sciences, they do not come naturally to us... [P]art of the difficulties of teachers and students with understanding of the natural sciences comes from the distance between their lifeworlds and the natural sciences.

> One way of talking is to say that the natural sciences are "alien" in some fundamental way to the lives and lifeworlds of teachers and students (p. 3).

Certainly those of us who had trouble with science in school can relate to that sentiment. Despite our ability to empathize with Bettencourt's perspective, however, there is an important reality that intrudes--current students must become better educated in science. This is specially true for those students who now comprise the majority of students in today's classrooms; minority students and ELL's. This paper reports on one attempt to improve science education for these, and all students.

Project Description

Forty elementary school teachers and ten bilingual teaching aides participated in a year-long series of classes. During that time they received thirty-three weeks (120 hours) of training in the activity based Full Option Science System (FOSS), Britannica, 1990). They also were trained in some aspects of complex instruction, a bilingual approach that develops thinking skills of language minority students (Cohen, 1989; DeAvila, 1986). A team of scientists, science educators, teacher educators, and district science specialist were responsible for providing the training. Performance data was collected by staff members during classroom visits during science instruction. Teacher and student journals and portfolios were also collected.

Some Preliminary Findings

As was noted previously, the project has been very

successful in getting teachers to implement activity-based science lessons, and to change their beliefs about how effective they are as science educators (Riggs et al., 1994):

> After project preparation, teachers were more likely to believe that students can learn and come up with explanations for their hands on experiences. The were also more likely to believe that students do possess ideas about science prior to instruction and that eliciting those ideas is an important instructional strategy. Additionally, they were more likely to believe that hands on experiences should precede formal teaching of science concepts and vocabulary (pp. 5-6, 1994).

Teacher journals add depth to the above findings. Journal entries such as the following were common:

> Teacher A
>
> I really enjoyed science today with my kids. We did water dome races. It was really fun. I could hear the kids' surprise when the biggest drop of water took off first, then the next in size and next etc. It was really a good way to learn and experiment... I wish that my teachers had taught me like this.
>
> Teacher B [ESL Teacher]
>
> ...[C]reo que la materia presentada por medio de un libro tiene mas informacion para el maestro. La ventaja de FOSS es que esta mas accesible, ya que conseguir textos in la

primera lengua es tan dificil.

[...I believe that lessons presented using textbooks has more information for the teacher. [But] The advantage of FOSS is that it is more accessible, [to students] given that it is so difficult to obtain texts in the primary language.]

Classroom observations of project and non-project teachers confirm that a significant shift from text-based to activity-based lessons was taking place among project teachers. The performance data analysis reported by Riggs et al (1994) also indicates that project teachers spent significantly less time in "teacher talk" and permitted more "student talk" and "student activity" in their classrooms.

The findings, however, are not so positive for the ELL's. As we noted above, teachers continued to have strong concerns about their ability to impact the science education of ELL's. Teacher responses our survey's still seem to reflect their concerns for ELL's and the project's need to change teacher beliefs that "limited English may inhibit their own or other students' learning of science" (Riggs, et al., 1994). Here again teacher journals give voice to concerns behind survey responses.

Teacher C

I feel that I teach science very well. I make learning science fun and interesting. However, the majority of my student[s] which are off task and discipline problems are the LEP students. My goal is to change this. I will seek

higher involvement by them and a higher achievement rate on assessments in regards to them.

Teacher D [Monolingual]

I am very concerned about my LEP students. They are the ones who seem neglected in my science groups. Students complain 'LEP's[2] are too slow.' 'We don't want [an LEP] student in my group.' I need and would like advice on getting LEP's more involved and less likely to exit my class hating science. LEP's complain, 'They go too fast,' They don't care.' 'They called me stupid.' When I took a survey on subjects you like and dislike the most, the majority of LEP's, had science at the top of the dislike list. Please bring a speaker or give a presentation on this.

Clearly this teacher and others in the project want to address the needs of ELL's but feel lacking in their ability to do so. It is equally clear that despite significant gains made by the project in getting participating teachers to actively promote science learning among their students there is still a need to expand and intensify the training related to the educational development of ELL's. Fortunately, teacher journals indicate that such training is likely to be successful. In reviewing teacher journals we noted that project bilingual teachers, who had received a special credential to teach in two

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[2] Limited English Proficient

languages did not report these concerns. In fact, they very often reported successes with all of their students.

Teacher A

This is the last day of our FOSS classes and I wanted to turn something that was fresh from the kids. So first thing this morning for writing the kids wrote about why they like science. I was very pleased with their stories. I think they are pretty good for 2nd graders. Some of them are student edited with partners and some are not edited at all. You can see the wide range of skills that exist in my class. The most exciting thing though, is that these kids like science. Another teacher came to my room me today and told me that the kids were always telling her how much they like science in Mrs._____'s class. That sure feels good. All the stories are in Spanish. But they are great! Thanks again for helping me change the way I teach Science. Both the kids and myself are really benefitting from the change.

Implications and Future Directions

The project goal of improving teachers' attitudes and beliefs regarding the teaching of science to all students was met to a significant degree. These results are important in that they address Lemke's and Bettencourt's concerns about how to help students penetrate the "alieness" of science and the discourse used in science teaching. Part of the answer is to rely less, a lot less, on teacher talk to teach science. As our results

indicate, activity-based lessons genuinely work to engage students and teachers as co-workers in the process of science education. However, there is still work to be done in helping teachers to meet the needs of ELL's. Several strategies are being implmented to address this issue.

First, project staff have increased the training in teaching ELL's through ESL techniques. A recent publication by Fatham, Quinn and Kessler (1992) describes some of the approaches that are currently being presented to teachers for the purpose of integrating science and language learning. Fatham et al. recommend strategies such as modifying language during science lessons to make it more comprehensible to ELL's. Focusing on key words, using shorter and less complex sentences, repitition of phrases containing key concepts and interspersing questions within discourse to check for comprehension by ELL's are a few of the strategies that are being provided to project teachers. Additionally, experienced bilingual teachers who are project participants are making formal presentations to their colleagues on how to use develop language through science lessons. Project teachers are encouraged to <u>always</u> make available the Spanish worksheets and other translated materials that are provided by FOSS. This gives ELL's the message that their primary language is important, valued and excepted in the learning of science.

Project staff are also designing instruments for measuring more directly the extent to which teachers are using the above-described strategies with ELL's. (See Appendix A for a draft of

one instrument.)

There still remains, however, an issue that needs to be addressed, not just by this project, but by all U.S. educators. That is the issue of how teachers can take the lead in changing beliefs, values and assumptions that hamper the effective and positive education of language minority students. As we noted at the beginning of this paper, many "habitudes"--unexamined beliefs--about these students continue to impact the educational processes in American classrooms. The comments quoted above, made by fellow students in project classrooms mirror the attitudes which pervade society. Teachers must take the lead in changing these attitudes and a good start is to change traditional practices. The words of Warren, Rosebery and Conant (1989), researchers working to improve the science education of Haitian students, are instructive here:

> The lesson [from their project] then, is that teacher's long established practices will be difficult to change as long as they continue to be functional in the classroom context. To change teachers' classroom practices requires a change in the culture of teaching and learning itself; the value of alternative practices must be demonstrated and experienced in contexts that are specifically designed to promote such practices over traditional ones... The [research] reported here argues that not only are language minority students capable of meeting the intellectual challenge posed by authentic science activity but that this activity itself is

capable of resolving the tension between disciplinary learning and language development that has frustrated bilingual education since its inception (p. 54-57).